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December 10, 1987

Mr. David M. Wham
Reclamation Hydrologist
Utah Division of Oil, Gas, & Mining
355 West North Temple
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Salt Lake City, Utah 84180-1203

Dear Mr. Wham:

RE: Comments on Texasgulf Inc., Cane Creek Mine, Notice of Intention to Commence Mining Operations and Mining and Reclamation Plan, Revised August 19, 1987.

In response to your September 24, 1987 request, our staff have completed a review of the above mentioned plan. A summary and specific comments regarding Texasgulf's Mine and Reclamation Plan are attached.

Our comments address water quality issues regarding surface and ground water discharges to the Colorado River from the facility, with respect to current mine operation and future mine reclamation.

It would appear to be advantageous for us to meet to discuss these water quality issues and to coordinate the involvement of our agencies. Please call at your earliest convience, to arrange for such a meeting.

If you have any questions regarding our comments please call Loren Morton (ground water issues) or Steven McNeal (surface water issues) at 538-6146.

Thank you for the opportunity to comment on the plan. We look forward to a cooperative effort between our agencies in protecting the water quality of the Colorado River.

Sincerely,

Don A. Ostler

Don A. Ostler, P.E.
Director
Bureau of Water Pollution Control

attachment

Ken Alkema, Director Department Environmental Health
Dave Arriotti, Southeast District Health Dept.
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Utah Bureau of Water Pollution Control

Comments On:

Texasgulf Inc., Cane Creek Mine, Notice of Intention to Commence Mining Operations and Mining and Reclamation Plan, revised August 19, 1987.

Summary

Most of the mine reclamation plan is based on the future use of existing brine extraction, evaporation, storage, leakage recovery, and injection systems. Unfortunately, not all aspects of the operation appear to have adequate design and construction to prevent and/or recover brine losses to the environment, i.e., soil, groundwater, and surface water. We recognize Texasgulf's efforts to contain and control surface discharges of brine to the Colorado River. However, information provided by the company and observations made by our staff indicate brine is lost to the subsurface environment from the following surface facilities at the site: 1) Evaporation Ponds, 2) Salt Storage Area, 3) Brine Lake and Dam, and 4) Plant Site.

Prevention of the seepage problem would best be accomplished by engineered liners and/or subliners for the facilities. However, we recognize the economic burden of such construction now that the facilities already exist. Thus one viable option to consider is subsurface brine recovery systems. This practice has already been partially implemented by Texasgulf.

Some subsurface brine recovery systems already exist at the site and are outlined below:

Facility	Subsurface Brine Recovery Systems
1. Evaporation Ponds	#1 Canyon Collection System and the #3 Canyon Collection System
2. Salt Storage Area	Pumping well field, wells TP-1, 2, and 3
3. Brine Lake and Dam	Catch pond at downstream toe of dam
4. Plant Site	None

All of these surface facilities have experienced brine and/or salt losses to the environment. Unfortunately, subsurface brine recovery systems have not been implemented at all the surface facilities. For those facilities with such recovery systems, effectiveness in reclaiming lost brine is unknown.

Consequently, we recommend the following course of action, in light of the economic burden to construct liners and the company's desire to use existing brine recovery systems in reclamation of the mine.

1. Where brine losses to the subsurface are known to occur, Texasgulf should conduct studies to quantify these losses. Initially this would require a water (brine) budget analysis of inflows, outflows, evaporation, and precipitation for each of the leaking facilities. Water balances should be performed for the evaporation ponds, tailings lake and dam, and the salt storage areas. A water budget analysis of the plant site would be of little use in that brine is not generally in intimate contact with the subsurface. However, other methods could be employed to estimate plant site losses to the subsurface.

2. A comparison should be made between the water budget determined brine loss to the subsurface, and the actual volumes of brine recovered by the existing recovery systems. In those cases where the existing recovery system is less than effective in reclaiming lost brines, Texasgulf should take steps to improve their recovery systems.

3. Once system effectiveness is demonstrated or the recovery systems are satisfactorily improved, Texasgulf should operate these systems simultaneously with operation of the mine. This ongoing action should prevent unnecessary salt pollution of the Colorado River.

4. Texasgulf should provide operating reports for all the recovery systems to demonstrate effective capture and collection of lost brines. This information could include: annual/quarterly water budget analyses, including volumes of recovery brines, depth to water table in pumping wells or piezometers; or other pertinent information.

5. The reclamation process would involve a cessation of salt harvesting from the Paradox Salt Formation, and the salt storage area, and a continuing operation of the brine recovery systems. These systems would operate until the quality of water recovered returned to background levels of ground water quality. For those systems involved with soil and subsurface leaching, recovery would continue until the captured water approached the water quality applied to the system.

   Because ground water TDS quality has been demonstrated to be poor at the site, our major concern is to protect the quality of the Colorado River. Information provided by Texasgulf indicates that the river acts as a local ground water sink. Therefore, brine losses that originate at the site add to the river salt load. The Colorado River Basin Salinity Control Forum has set an objective of no industrial salt discharge to the river. Accordingly, industrial facilities should design their systems for no discharge of process salt water to the river via either surface water runoff or ground water seepage. This limitation applies to Texasgulf's current operation of the mine with regard to the cumulative surface water runoff and ground water seepage of brine from the evaporation ponds, salt storage area, brine lake, and plant site. We recommend that the company be committed to a demonstration and improvement schedule, by which Texasgulf would evaluate existing brine recovery operations and make system improvements where necessary. We also recommend that Texasgulf provide periodic and regular reports detailing the operation of all brine recovery and monitoring well systems during operation of the mine and mine reclamation.

Specific Comments

Evaporation Ponds

1. Seepage Collection Systems

   a) The volume of seepage losses from the evaporation ponds is unknown. A water balance analysis should be undertaken to quantify the volume of brine losses to the subsurface. Comparison of brine seepage losses, with volumes of brine recovered should indicate how effective current systems are in recovering brine seepage. If it is shown that the current recovery systems are not satisfactorily effective in recovering all seepage losses, steps should be taken to improve brine recovery operations.

   b) Design of existing seepage recovery systems should be evaluated to ensure that they are effective in collecting all seepage they intercept. Observations made by our staff during field inspections of the #3 Pond Canyon Collection System demonstrate that a significant amount of brine seepage flows, unchecked, beneath the lowermost earthen dam to the Colorado River. This recovery system should be modified to remediate pollution of the river. All other brine recovery systems should be evaluated by Texasgulf and the State to ensure recovery effectiveness. Any recovery system construction or modification design should be submitted to the Bureau of Water Pollution Control for review and approval. An approvable design will also address adequate ongoing operation and maintenance of any recovery system.

   c) Only after the #1 and #3 Canyon Collection Systems are shown effective in collecting all seepage from the evaporation ponds, will it be apparent if they are adequate for use in the leaching activities planned for future mine reclamation.

2. Surface Water Control Systems.

   a) Contaminated stormwater should be contained on site and prevented from entering the Colorado River. Figure 2-3 indicates that a culvert exists in the lowermost earthen dam in the #3 Pond Canyon Collection System. Estimates provided, page 11-17, indicate that only 13.4% of all the precipitation that falls on the collection system's drainage area is actually retained and recycled to the salt harvesting operation. Losses to evaporation, seepage, and recovery efficiency are unknown, however it is apparent that an inordinant amount of salt laden stormwater is released by Texasgulf to the Colorado River. Texasgulf should take steps to prevent this salt from polluting the river by retaining all contaminated stormwater runoff on site and recycling the brines back into the salt harvesting operations. We expect that the design of surface water control and brine seepage recovery systems would be coordinated in order to maximize salt recovery efficiency. Resolution of this problem will improve current operation and may provide for viable future reclamation of the evaporation ponds.

b) Texasgulf's proposal to divert stormwater runoff from reclaimed areas and directly discharge it to the Colorado River during the reclamation process, thereby minimizing infiltration and subsequent seepage for recovery; has technical and economic merit (Section 11.C.6). However, measures should be taken to monitor salinity content to ensure compliance with Colorado River Salinity Standards described above. In the future this storm water discharge will likely require a Utah Pollutant Discharge Elimination System (UPDES) permit.

c) Estimates of volumes of surface water runoff to be handled by Texasgulf during reclamation are completely dependent on historic volumes of brine recovered by the existing #3 Pond Canyon Collection System (see Section 11.C.6, pp 11-16 to 11-20). Unfortunately, the system is less then effective in recovering all brine seepage and stormwater runoff in the canyon. Consequently, Texasgulf's assumptions are minimum estimates at best. Modification of the #3 Pond Canyon Collection System to capture all the stormwater and recover all the brine seepage would allow more accurate prediction of the volumes of water that will need management during reclamation. Operation of an effective stormwater and brine recovery system will provide Texasgulf with more than enough data necessary to adequately design a stormwater control system for use during mine reclamation. Design of reclamation systems should be based on observation and verifiable data, and not on assumptions or theoretical information.

3. Leaching of Evaporation Pond Sites During Reclamation.

a) Texasgulf's proposal to only leach the uppermost 3 feet of the soil column is unacceptable. Texasgulf is responsible for all salts and brines applied to the land surface and subsurface during the course of their operation. The leaching system should be operated until total dissolved solids content (TDS) of the collected seepage approaches the TDS content of the fresh water applied.

b) Texasgulf's proposal to leave 2-3 inches of the compacted salt base on the liners and then mechanically remove the salt and the liners to the proposed landfill site (p. 11-28 and 29) will result in an unnecessary increased exposure of the environment to salt losses. We recommend that the compacted salt base be dissolved with fresh water while in-situ and the resultant brine be removed to another lined pond for evaporation. Salt solids could then be processed in the company salt harvesting operation or reinjected into the mine cavity.

c) Removal of all salts from soils and bedrock beneath the evaporation ponds may be expedited via flood irrigation of the site rather than by the sprinkling irrigation method proposed by the company. This should include removing the synthetic liners and flooding and maintaining the evaporation cells with fresh water during the inital reclamation process.

Salt Storage, Brine Lake, and Landfill

1. Brine Seepage from Salt Storage Area.

a) Statements made that only one (1) fault in the salt storage area acts as a conduit to seepage (p. 9-2) is unsupported with hydrogeologic data. The geologic map provided (Appendix 1, Figure 2) indicates eight (8) separate faults intercept the salt storage area. However, Texasgulf has installed brine recovery wells (TP-1, 2 and 3) on only one of the eight faults. Interestingly enough, this fault does not intercept the present salt storage pile (compare Reclamation Plan Map 2-2 with Appendix 1, Figure 2). This raises a question regarding how many of the other faults and joints in the vicinity act as brine seepage conduits. Texasgulf should assess brine losses along these fractures and take steps to remediate where necessary. This may include the construction of a monitoring well network. A water budget analysis for the salt storage area would be a good first step. Subsurface brine recovery measures may also be necessary.

Apparently Texasgulf has plans to remove the salt in the salt storage area and process it for sale. Statements made on pages 4-3 and 4-4 indicate that the company plans to dissolve the salt in-situ. This infers that fresh water will be applied to the salt stockpile and the resultant brine extracted from the Brine Lake. This process will increase seepage losses of brines from the salt storage area. The lack of a liner beneath the salt and the high density of fractures in the foundation causes the area to be highly permeable. Such permeability heightens the need for subsurface brine recovery.

Hydrogeologic information presented in Appendix 1 (p. 19) indicates that the local aquifer system is confined to vertical fractures in the bedrock units at the vicinity. A conceptual ground water flow model presented by the company (Appendix 1, Figure 9) indicates that ground water in the aquifer discharges to the Colorado River, which acts as a local sink. Transmissivity of the aquifer system is extremely high as evidenced by the accidental flooding of the Cane Creek Mine via Texasgulf Well #7 (Appendix 1, p. 28). The same fault system that was intercepted by the number #7 well, also underlies the western portion of the salt storage area (compare Appendix 1 Figures 1 and 2). Consequently, there is a high probability that brine losses to ground water have been and will be experienced, particularly when Texasgulf begins solution mining of the salt storage area. These losses would likely impact the salinity of the Colorado River. Texasgulf should evaluate all brine losses in the vicinity of the existing salt storage area. Where necessary, steps should be taken by the company to recover all brine losses to ground water and recycle these brines into their salt harvesting operation.

b) Texasgulf's claim that all brine lost along the fault of wells TP-1, 2, and 3 is reclaimed by maintaining the local water table below river level, is unsubstantiated. Density differences of the fluids involved; brine, ground water, and the Colorado River, dictate how much drawdown is necessary to completely capture lost brines. Texasgulf should quantify the density of the fluids involved, and the drawdown required for total capture.

In this and any other well recovery system for lost brine, regular monitoring of the water table elevation (amount of drawdown) and volume of the water/brine purged is essential to ensuring proper system operation. We recommend that such monitoring be implemented for this and any other well recovery system for lost brine.

2. Seepage from Brine Lake.

No information has been provided regarding liner construction of the reservoir. Previous discussions with Texasgulf staff have indicated that no engineered liner exists beneath the reservoir. Drawing 9-1 of the plan indicates that during the design stage of the project, grouting of open joints in the reservior area was to be accomplished at the direction of the soils engineer (general note #4). However, no reports verifying such grouting have been included in the mine plan submitted. If open joints and faults were not grouted or grouted adequately, then there is an extremely high possibility of substantial brine losses to ground water and the Colorado River. The occurrence of a major fault under the Brine Lake impoundment (see Appendix 1, Figure 2) and the pronounced and persistent joints in the impoundment's foundation, (Maps 2-2, 2-3 and 2-4) heighten concern over brine losses to the Colorado River.

We recommend that Texasgulf be required to provide the following:

a) Evidence of adequate grouting of open joints and faults in the resevior's foundation of the Brine Lake,

b) Development of a ground water monitoring well network, and

c) A water budget analysis for the Brine Lake, in an attempt to quantify brine losses to seepage. If it is apparent that significant amounts of brine are lost to seepage, then Texasgulf should take measures to recover the brine seepage by construction of a brine recovery well field or some other approved system.

3. Brine Lake Dam

a) Information provided in the plan indicates that the dam's core was constructed of silty sand (p. 9-51). This may explain why brine seepage appears at the dam's downstream toe, necessitating the use of a catch pond to prevent surface runoff of the brine. It is unknown if the catch pond is capable of recovering all brine losses thru the dam. Losses from the catch pond are also of concern due to the prevalence of open joints in the locality (see Map 2-3). The existence of a fault at the ponds west margin (Appendix 1, Figure 2) also suggests leakage potential from the catch pond. We recommend Texasgulf make an evaluation of the efficiency of the catch pond in recovering all brine seepage thru the Brine Lake Dam. The volumes of this loss and recovery should also be included in the Brine Lake water budget analysis mentioned in point 2 above.

b) No information has been provided on the grouting of open joints during construction of the Brine Lake dam. Potential losses along these conduits should not be neglected in the water balance evaluation of the Brine Lake nor in any brine recovery operation that may be required.

4. Any system constructed to recover brine seepage at the Salt Storage-Brine Lake area should be operated concurrently with the operation of the mine to prevent salinity discharges to the Colorado River. These same systems should also be operated during reclamation of the mine until the ground water recovered returns to background concentrations of salts and/or total dissolved solids.

5. Proposed Landfill in Salt Storage Area.

a) Statements made on page 11-24 that leaching of the landfill will "...eliminate any long term possibility of salt reaching the Colorado River after abandonment of the landfill" are incorrect. Appendix 1, Figure 9 indicates that ground water beneath the site discharges directly to the Colorado River. Therefore, all brine leachates that are lost to ground water will eventually impact the river. We recommend that Texasgulf take all possible measures to prevent the deposition of salt in the landfill (see comments: Evaporation Ponds 3(c), above, and Plant Site 2 (b) below). Failure to prevent salt from being deposited in the landfill may also impede the biodegradation of putrefiable materials.

b) Consultation with the Bureau of Solid and Hazardous Waste has added several important comments regarding the proposed landfill and the Utah Code of Solid Waste Regulations:

1) Soil contaminated by lubricating oils, diesel fuels, chemical reagents, etc., must be chemically tested by a State approved laboratory before excavation or disposal to verify that they are non-hazardous.

2) Current regulations prohibit construction of solid waste landfills immediately above fractured bedrock.

3) State policy prohibits the leaching of any solid waste landfill.

4) Future regulations may require the construction of a liner for the landfill.

Consequently, the design of the landfill should include a liner. It is expected that leaching of the landfill will be prohibited, therefore the reclamation plan should be adjusted accordingly. Texasgulf should take all steps necessary to prevent salts from being deposited in the landfill.

Plant Site

1. Current Operations

   a) Steps should be taken by Texasgulf to prevent the loss of salt to soils and ground water. Previous inspections by our staff have observed stockpiles of salt on natural ground surfaces without the benefit of an impermeable protective liner. Lined storage areas should be constructed to contain salt solids and stormwater runoff. Salt handling and transfer areas should be designed to prevent the loss of salt solids, brines, and stormwater to soils and ground water. We recommend that Texasgulf accomplish the following:

      1) When practical, measures should be taken and structures constructed or retrofitted to prevent the loss of salt and brines to soils and ground water, and

      2) Where this prevention is not practical, brine recovery systems should be constructed to capture subsurface brine emissions before they reach the Colorado River.

   b) Texasgulf should undertake studies to evaluate the presence and amount of brine losses to ground water and to the Colorado River from the plant site. This may include the construction of a monitoring well network. If these studies indicate groundwater has or is being contaminated by salt losses, Texasgulf should take prevention measures outlined above, to reclaim the salts lost to subsurface soils and groundwater. Any recovery system constructed could also be used in future reclamation of the plant site.

   c) The sanitary treatment system should be evaluated by the company for design capacity and compliance with the wastewater disposal regulations. A summary of this evaluation should be contained in the mine plan. The system should also be inspected by the Environmental Health district engineer on a regular basis to evaluate its operation and maintence. Daily records of the treatment system should be kept by the company and regularly submitted to the Utah Bureau of Water Pollution Control.

2. Plant Site Reclamation

   a) A leach brine collection trench is illustrated on Figure 11-1 of the mine plan. However, no information is provided on its design, construction and operation in reclamation of the plant site. Consequently, it is not possible to determine if the system is adequate at this time. We recommend that Texasgulf provide more information on this proposed brine recovery system.

   b) Salt Contaminated Soils - Texasgulf's proposal to remove salt contaminated soils and dispose of them in the proposed landfill for leaching is unacceptable, in that it poses an unnecessary increased risk of contamination to the environment. We recommend that Texasgulf desalinate soils at the plant site. This may be accomplished by various means including:

1) Construction of an in-situ salt leaching and brine recovery system. This could include sprinkling/flood irrigation of contaminated areas and brine recovery via a engineered collection trench or pumping wellfield.

2) Construction of a lined, above ground leaching area where contaminated soils could be stock piled, leached, and returned to their original location. Brine leachates would be collected and handled in the same manner as other recovered brines, or

3) A combination of these two methods, or perhaps other methods that would be State approved.

c) Oil, Fuel, Reagent, etc. Contaminated Soils - as mentioned in landfill comments above, these soils should be tested to determine that they are non-hazardous. The disposal of these soils should be consistent with the Utah Solid and Hazardous Waste Act, and any other applicable state or federal regulatory requirements.

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